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## Flagellar hydrodynamics of biological and biomimetic micro-swimmers

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# PROPOSITIONS

belonging to the PhD thesis

## Flagellar hydrodynamics of biological and biomimetic micro-swimmers

by

Sandeep Namdeo

1. The reversal of swimming direction is particularly important for micro-object manipulation in confined flow geometries. *(Chapter 1)*
2. The coordinated operation of ATP-powered dyneins is responsible for the flagellar waveforms and motility observed in nature. *(Chapter 2)*
3. Mastigonemes work as cilia and cause a reversal in swimming direction compared to a smooth flagellum. *(Chapter 3)*
4. A generic strategy to control propulsion at low-Reynolds numbers is by tuning the actuation sequence of two independently controlled degrees-of-freedom. *(Chapter 4)*
5. Biomimetic propulsive systems can be designed by exploiting the flagellar undulations for forward propulsion and synchronous ciliary beating of the mastigonemes for direction reversal. *(Chapter 4)*
6. Bi-directional bacterial swimming can be achieved by forming a chiral shape using magnetic forces, prior to actuation. *(Chapter 5)*
7. A partially-magnetized elastica can mimic swimming of either eukaryotic or prokaryotic flagellated micro-organisms when subjected to an oscillatory or rotating magnetic field, respectively. *(Chapter 4 & 5)*